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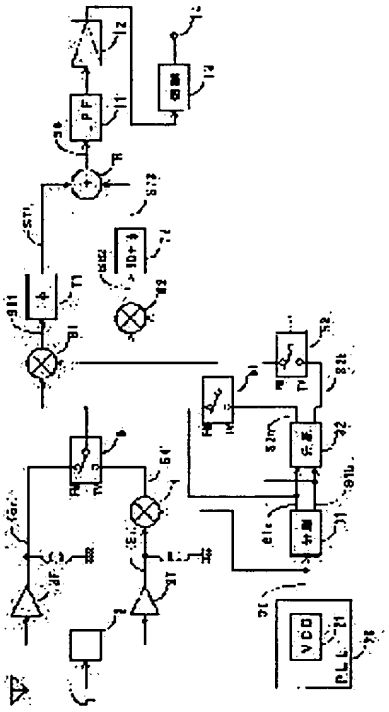
(54) RADIO RECEIVER

(57)Abstract:

PROBLEM TO BE SOLVED: To receive the sound of television broadcasting through the use of a local oscillation circuit for FM broadcasting reception.

SOLUTION: A first mixer circuit 4, a pair of second mixer circuits 61 and 62, a pair of phase shift circuits 71 and 72, an arithmetic circuit 8 operating the output signals from a pair of the phase shift circuits 71 and 72, a filter 11 for taking out an intermediate frequency signal from the arithmetic circuit 8 and a demodulation circuit 13 demodulating a sound signal from the output signal of the filter 11 are provided. FM broadcasting is received by a single super heterodyne system by using the mixer circuits 61 and 62. The sound of television broadcasting is received by a double super heterodyne system by using the mixer circuit 4 and the mixer circuits 61 and 62. A second local oscillation signal at that time is formed by frequency-dividing the first oscillation signal by frequency division circuits 31 and 32.



LEGAL STATUS

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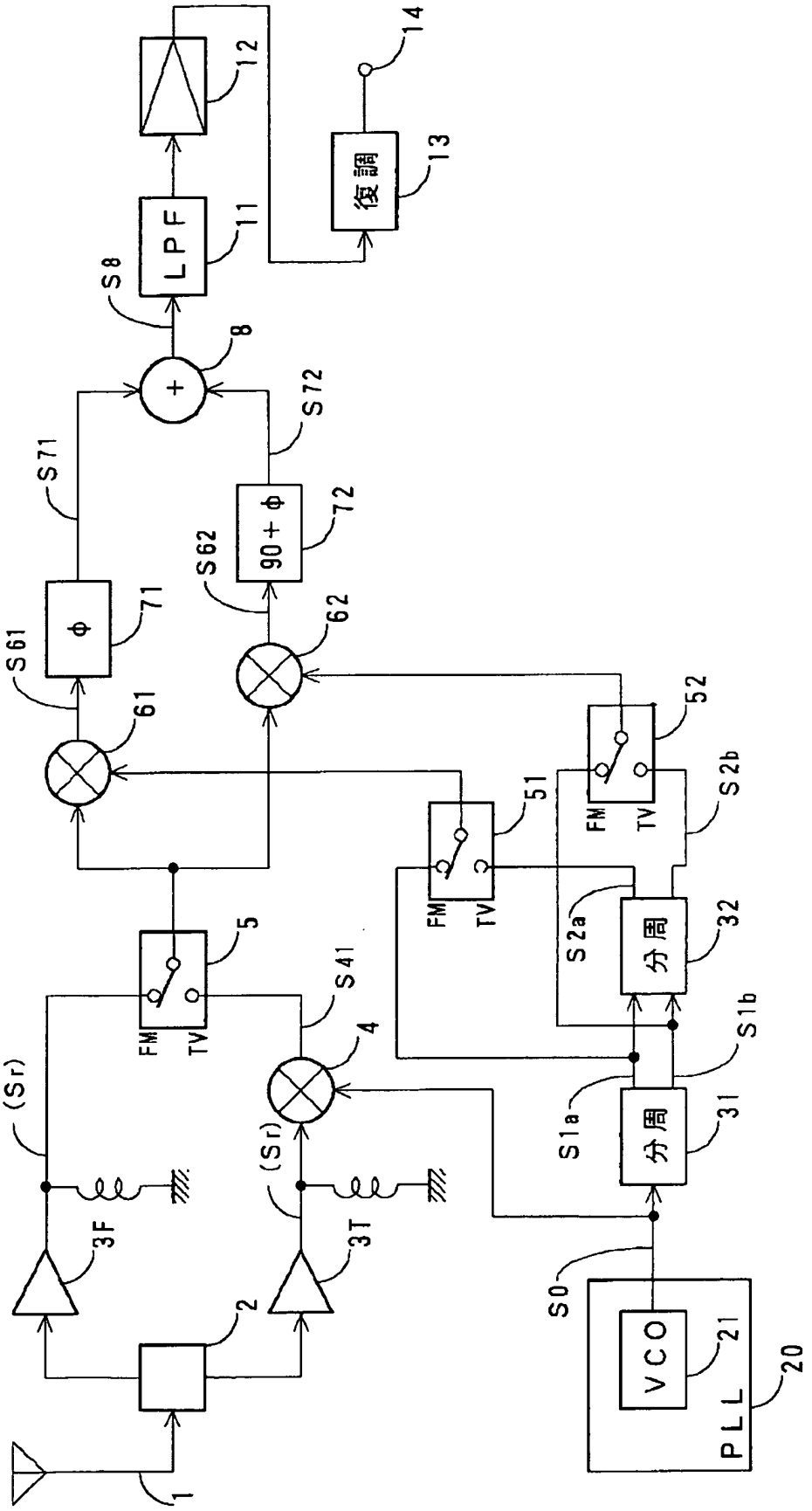
DRAWINGS

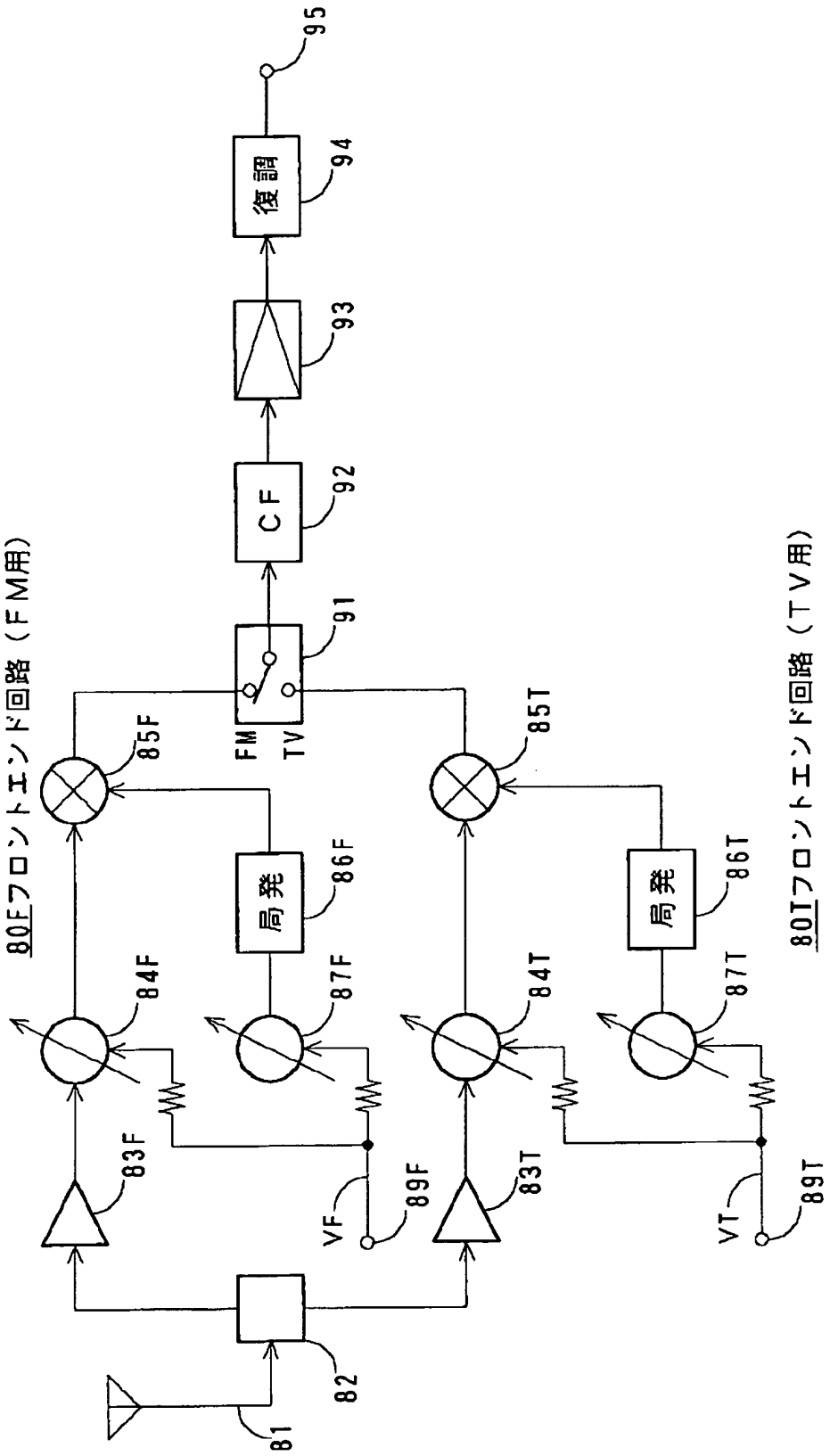
[Drawing 2]

CH	fr (MHz)	f0 (MHz)	fi2 (kHz)
4	175.75	156.35	143.75
5	181.75	161.7	162.5
6	187.75	167.025	153.125
7	193.75	172.35	143.75
8	197.75	175.9	137.5
9	203.75	181.25	156.25
10	209.75	186.575	146.875
11	215.75	191.9	137.5
12	221.75	197.25	156.25

[Drawing 1]


1
2
3F
3T
4
5
FM
TV
(Sr)
S41
61
62
71
72
S61
S62
S71
S72
8
+
S8
LPF
11
12
復調
13
14
51
52
S2b
S2a
分周
32
S1b
S1a
31
S0
VCO
21
PLL
20

[Drawing 3]



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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to a radio set.
[0002]
[Description of the Prior Art] The small radio set currently used in Japan is changing to the thing of three bands which the voice of the television broadcasting of a VHF band can also receive from what can receive two bands of FM broadcasting and AM broadcast.
[0003] And since the sound signal in television broadcasting is broadcast by FM modulation in this case, the receive section of the voice of television broadcasting can use also [system / of FM broadcasting / intermediate frequency signal] except for that front end circuit.
[0004] Drawing 3 shows an example of the FM/TV receive section of 3 band receiver according to such an idea.
[0005] That is, at the time of reception of the low band (channel [1st] - the 3rd channel) of FM broadcasting and television broadcasting, the broadcast wave signal is supplied to front end circuit 80F for FM broadcasting through a branch circuit 82 from an antenna 81. These front end circuit 80F have RF amplifier 83F, RF tuning circuit 84F, mixer circuit 85F, and local oscillation circuit 86F.
[0006] And while local oscillation circuit 86F are constituted by VCO in this case, these local oscillation circuit (VCO) 86F constitute a part of PLL for FM broadcasting. For this reason, although resonance circuit 87F of local oscillation circuit 86F do not carry out illustration, they are constituted by a coil and variable capacitance diode, and control voltage VF is supplied to that variable capacitance diode through terminal 89F.
[0007] Moreover, although tuning circuit 83F do not carry out illustration, it is constituted by a coil and variable capacitance diode and control voltage VF is supplied to the variable capacitance diode.
[0008] In this way, if the division ratio of the good variations circumference way of that PLL is changed, control voltage VF will change and the tuning frequency of tuning circuit 83F and the resonance frequency of resonance circuit 87F will change with these change corresponding to control voltage VF.
[0009] Therefore, FM broadcast wave signal of the received frequency made into the purpose is changed into the intermediate frequency signal whose center frequency is 10.7MHz, and is taken out from mixer circuit 85F. In addition, let the receiving range of front end circuit 80F be 76MHz - 108MHz, i.e., the band of FM broadcasting, and the band of the low band of television broadcasting in this case.
[0010] And this intermediate frequency signal is supplied to the FM demodulator circuit 94 through the signal line of the ceramic filter 92 -> amplifier 93 for switching circuit 91 -> intermediate frequency filters switched to the condition of drawing at the time of FM reception, a sound signal gets over, and this sound signal is taken out by the terminal 95.
[0011] Therefore, the voice of the low band of FM broadcasting and television broadcasting is receivable.
[0012] On the other hand, at the time of reception of the voice of the high band (channel [4th] - the 12th channel) of television broadcasting, the broadcast wave signal is supplied to front end circuit 80T

for the voice of television broadcasting through a branch circuit 82 from an antenna 81. These front end circuit 80T are constituted like front end circuit 80F, are replaced with Suffix F in a corresponding circuit, Suffix T is attached, and explanation is omitted.
[0013] And in front end circuit 80T, frequency conversion of the FM sound signal of television broadcasting is carried out to the intermediate frequency signal whose frequency is 10.7MHz. However, let the receiving range of front end circuit 80T be the band of 175MHz - 222MHz, i.e., the high band of television broadcasting.
[0014] And the intermediate frequency signal from front end circuit 80T is supplied to the FM demodulator circuit 99 through the signal line of the ceramic filter 92 -> amplifier 93 for switching circuit 91 -> intermediate frequency filters switched to the condition contrary to that of drawing at the time of reception of the voice of television broadcasting, a sound signal gets over, and this sound signal is taken out by the terminal 95.
[0015] Therefore, the voice of the high band of television broadcasting is receivable.
[0016] According to the receiving circuit of drawing 3 as mentioned above, the voice of FM broadcasting and television broadcasting is receivable. And since a switching circuit 91 to the latter part is common to the object for FM reception, and reception of the voice of television broadcasting in that case, it is advantageous in respect of cost etc.
[0017]
[Problem(s) to be Solved by the Invention] However, in an above-mentioned receiving circuit, in front end circuit 80F for FM broadcasting, tuning circuit 84F and resonance circuit 87F are needed, and tuning circuit 84T and resonance circuit 87T are needed in front end circuit 80T for the voice of television broadcasting. And a coil and variable capacitance diode are needed in every resonance circuit (tuning circuit).
[0018] For this reason, cost will go up compared with the receiver of two bands of old FM/AM.
[0019] This invention tends to solve such a trouble.
[0020]
[Means for Solving the Problem] In this invention, the 1st oscillator circuit which forms the 1st local oscillation signal, and the voice broadcast wave signal of television broadcasting for this reason, with the local oscillation signal of the above 1st While the 1st mixer circuit which carries out frequency conversion to the 1st intermediate frequency signal, the 1st intermediate frequency signal of the above, and the broadcast wave signal of FM broadcasting are supplied alternatively This supplied signal with 2nd 1 to local oscillation signal with which a phase intersects perpendicularly mutually One pair of 2nd mixer circuits which carry out frequency conversion to one pair of intermediate frequency signals, and one pair of phase-shifting circuits which perform phase shift processing to the one above-mentioned pair of intermediate frequency signals outputted from this 2nd mixer circuit, The arithmetic circuit which outputs a signal including the intermediate frequency signal of the broadcast wave signal which calculates the output signal of one pair of these phase-shifting circuits, and is made into the purpose, The filter which takes out the intermediate frequency signal of the broadcast wave signal made into the above-mentioned purpose from the output signal of this arithmetic circuit, It considers as the radio set it was made to have the demodulator circuit which the output signal of this filter is supplied and restores to a sound signal, and the frequency divider which carries out dividing of the local oscillation signal of the above 1st, and forms the local oscillation signal of the above 2nd.
[0021] Therefore, the voice of FM broadcasting and television broadcasting is receivable with one oscillator circuit.
[0022]
[Embodiment of the Invention] Drawing 1 shows one gestalt of the FM/TV receive section of 3 band receiver by this invention. This receive section receives the voice of the low band (channel [1st] - the 3rd channel) of FM broadcasting and television broadcasting with a single superheterodyne system, and that intermediate frequency is 150kHz.
[0023] That is, at the time of reception of the low band of FM broadcasting and television broadcasting, the switching circuits 5, 51, and 52 for a band switch are connected to the contact by the side of FM by

the microcomputer for system controls (not shown), as shown in drawing. And a broadcast wave signal is supplied to the mixer circuits 61 and 62 the I-axis of orthogonal transformation, and for Q-axes through the signal line of the FM side contact of the antenna 1 -> branch circuit 2 -> high frequency amplifier 3F -> switching circuit 5.

[0024] In addition, the broadcast wave signal Sr made into the purpose is because of being easy here. Sr=Er-sinomegart omegar=2pifr ... (1) fr: Suppose that it is a carrier frequency. Moreover, in future signal processing, since the relative phase (and amplitude) of each signal is only related, the initial phase of each signal omits in an upper type and future explanation.

[0025] Furthermore, in VCO21 of PLL20, the local oscillation signal S0 of ** is formed. Here, it is S0=E0 and sinomega0tomega0=2pif0. Moreover, oscillation frequency f0 f0=(fr+fi) x2 ... (2) fi: Intermediate frequency. It may be fi=150kHz.

[0026] And this oscillation signal S0 is supplied to a frequency divider (counter) 31, and dividing is carried out to dividing signal S1a and S1b b and a phase cross at right angles mutually on one half of frequencies. namely, -- S1 a=E1 and cosomega1t S1 b=E1 and sinomega1t omega1=2pi (f0/2) ... Dividing is carried out to signal S1a of (3), and S1b.

[0027] And these signal S1a and S1b are supplied to mixer circuits 61 and 62 as a local oscillation signal through the FM side contact of switching circuits 51 and 52, multiplication is carried out to Signal Sr, and the following signals S61 and S62 are taken out from mixer circuits 61 and 62. Namely, S61=Sr-S1 a=Er-sinomegart-E 1 and cosomega1 t=alpha {sin(omega r+omega 1) t+sin(omega r-omega 1) t} S62=Sr-S1 b=Er-sinomegart-E 1 and sinomega1 t=alpha {-cos(omega r+omega 1) t+cos(omega r-omega 1) t}

The signals S61 and S62 shown by that of alpha=Er-E 1 / 2 are taken out.

[0028] And since the signal component of angular frequency (omega r-omega 1) is used as an intermediate frequency signal among these signals S61 and S62, and the signal component of angular frequency (omega r+omega 1) is removed so that it may mention later, and it is easy, it will be set to S61= alpha-sin (omega r-omega 1) tS62= alpha-cos (omega r-omega 1) t if the signal component of the angular frequency (omega r+omega 1) of an upper type is disregarded.

[0029] And it is the image signal Sm at this time. Since it is Sm=Em-sinomegamtomegam=omega 1+omegaiomegai=2pifi, if the image signal Sm is included in the broadcast wave signal Sr from the tuning circuit 1, the signals S61 and S62 at this time serve as S61= alpha-sin (omega r-omega 1) t+beta-sin (omega m-omega 1) tS62= alpha-cos (omega r-omega 1) t+beta-cos (omega m-omega 1) t beta=Em-E 1/2.

[0030] And since it is omega r<omega 1<omegam at this time, an upper type is set to S61= alpha-sin (omega r-omega 1) t+beta-sin (omega m-omega 1) t=-alpha-sin (omega1-omegar) t+beta-sin (omega m-omega 1) tS62= alpha-cos (omega r-omega 1) t+beta-cos (omega m-omega 1) t=alpha-cos (omega1-omegar) t+beta-cos (omega m-omega 1) t.

[0031] And these signals S61 and S62 are supplied to phase-shifting circuits 71 and 72. These phase-shifting circuits 71 and 72 are constituted by the active filter which used a capacitor, a resistor, and O ** amplifier. And in a phase-shifting circuit 71, the phase shift only of the value phi is carried out, a signal S61 is made into a signal S71, in a phase-shifting circuit 72, the phase shift only of the value (phi+90 degrees) is carried out, and a signal S62 is made into a signal S72 for it.

[0032] Therefore, the signal with which only the value phi carried out the phase shift of the S71= signal S61

= - alpha-sin {(omega1-omegar) t+phi}
+ Beta-sin {(omega m-omega 1) t+phi}

The signal with which only the value (90degree+phi) carried out the phase shift of the S72= signal S62

= Alpha-cos {(omega1-omegar) t+90degree+phi}
+ Beta-cos {(omega m-omega 1) t+90degree+phi}
= - alpha-sin {(omega1-omegar) t+phi}
- Beta-sin {(omega m-omega 1) t+phi}

It becomes.

[0033] Since only the phase contrast between a signal S71 and a signal S72 is a problem in now, when the phase phi is common, and that phase phi is disregarded in these signals S71 and S72, and an upper type S71= - Alpha-sin(omega1-omegar) t+beta-sin(omega m-omega 1) t It is set to S72=-alpha-sin (omega1-omegar) t-beta-sin (omega m-omega 1) t.
[0034] And these signals S71 and S72 are supplied and added to an adder circuit 8, and it is an adder circuit 8. S8=S71+S72 = - Alpha-sin(omega1-omegar) t+beta-sin(omega m-omega 1) t + {- alpha-sin (omega1-omegar) t-beta-sin (omega m-omega 1) t}
= The signal S8 shown by -2 alpha-sin (omega1-omegar) t is taken out.
[0035] and -- if (3) and (1) type are substituted for this formula -- S8=-2 alpha-sin -- {(although set to 2pi(f0/2)-2pifr}t, if (2) types are substituted further -- S8=-2 alpha-sin -- {(set to 2pi(fr+fi)-2pifr}t=-2 alpha-sin 2pifitfi=150kHz.))
[0036] Therefore, a signal S8 is an intermediate frequency signal of the purpose and the broadcast wave signal Sr. Moreover, even if the image signal Sm is included in the broadcast wave signal Sr, in this intermediate frequency signal Si, the signal component by the image signal Sm will be canceled and contained.
[0037] In this way, the intermediate frequency signals Si (and signal component of angular frequency (omega r+omega 1) etc.) changed from the broadcast wave signal Sr are taken out from an adder circuit 8.
[0038] And this intermediate frequency signal Si is supplied to the low pass filter 11 for intermediate frequency filters. This low pass filter 11 is constituted by the active filter which used the capacitor, the resistor, and the operational amplifier, an unnecessary signal component is removed, and only an intermediate frequency signal S8 is taken out.
[0039] And this taken-out intermediate frequency signal S8 is supplied to the FM demodulator circuit 13 through the limiter amplifier 12, a sound signal gets over, and this sound signal is taken out by the terminal 14.
[0040] And since it is fr=f0/2-fi from (2) types, if the oscillation frequency f0 of VCO21 is changed in 152.3 to 216.3MHz in this case, since received frequency fr changes for 76MHz - 108MHz, it can receive the voice of the low band (channel [1st] - the 3rd channel) of FM broadcasting and television broadcasting.
[0041] On the other hand, the voice of the high band (channel [4th] - the 12th channel) of television broadcasting receives with a double superheterodyne system, the 1st intermediate frequency is 19.4MHz - 24.5MHz, and the 2nd intermediate frequency is about 150kHz (both of the intermediate frequencies change with receiving channels).
[0042] That is, at the time of reception of the high band of television broadcasting, the switching circuits 5, 51, and 52 for a band switch are connected to the contact by the side of TV contrary to drawing by the microcomputer for system controls. And a broadcast wave signal is supplied to the 1st mixer circuit 4 through the signal line of the TV side contact of the antenna 1 -> branch circuit 2 -> high frequency amplifier 3T -> switching circuit 5. Moreover, the oscillation signal S0 of VCO21 is supplied to the 1st mixer circuit 4 as a local oscillation signal.
[0043] In this way, in a mixer circuit 4, the multiplication of Signal Sr and the signal S0 is carried out, and the following signals S41 are taken out from a mixer circuit 4. Namely, S41=Sr-S0= Er-sinomegart-E 0 and sinomega0 t=gamma {-cos(omega r+omega 0) t+cos(omega r-omega 0) t}
The 1st intermediate frequency signal S41 shown by gamma=Er-E 0 / 2 is taken out.
[0044] And since the signal component of angular frequency (omega r-omega 0) is used as the 1st intermediate frequency signal among this signal S41, and the signal component of angular frequency (omega r+omega 0) is removed, and it is easy, it will be set to S41= gamma-cos (omega r-omega 0) t if the signal component of the angular frequency (omega r+omega 0) of an upper type is disregarded.
[0045] Moreover, omega r-omega 0=omegai1=2pifi1, then a frequency fi1 are the 1st intermediate frequency here.
[0046] And this signal S41 is supplied to mixer circuits 61 and 62 through the TV side contact of the switching circuit 5 for a band switch.

[0047] Moreover, signal S1a from a frequency divider 31 and S1b are supplied to a frequency divider (counter) 32, and dividing is carried out to signal S2a and S2b 2b and a phase cross at right angles mutually on one fourth of frequencies. namely, -- S2 a=E2 and cosomega2t S2b=E2 and sinomega2t omega2=omega 1/4 =2pi (f0/8) ... Dividing is carried out to signal S2a and S2b which are shown by (4).
[0048] And these signal S2a and S2b are supplied to mixer circuits 61 and 62 through the TV side contact of switching circuits 51 and 52, and multiplication is carried out to a signal S41, respectively.
[0049] Therefore, from an adder circuit 8, it is like the time of reception of FM broadcasting henceforth. S8=S71+S72 =-2 delta-sin {omega2- (omega r-omega 0)} t ... The 2nd intermediate frequency signal S8 shown by (5) delta=gamma-E 2/2 is taken out.
[0050] And this 2nd intermediate frequency signal S8 is supplied to the FM demodulator circuit 13 through a low pass filter 11 and amplifier 12, a sound signal gets over, and this sound signal is taken out by the terminal 14.
[0051] And it is as the voice carrier frequency fr of the high band of television broadcasting being shown in the left column of drawing 2 in this case. Moreover, (4) types are substituted for omega2- (omega r-omega 0) =2pifi2, then this formula in (5) types, and it is 2pifi2=omega2. - (omega r-omega 0)

= 2pi (f0/8) - (2pifr-2pif0)
therefore It is set to fi2=9/8 and f0-fr.
[0052] Therefore, if it is made to change as the oscillation frequency f0 of VCO21 is shown in the inside column of drawing 2 among 156.35MHz - 197.25MHz, a frequency fi2 will become like the right column of drawing 2 , and will be set to about 150kHz. Therefore, the voice of the high band of television broadcasting can be received.
[0053] In addition, although the 2nd intermediate frequency fi2 has shifted from the intermediate frequency of 150kHz at the time of reception of FM broadcasting at this time, since that gap is not so large as it shifts from the proportional region of the recovery property of a demodulator circuit 13, it is satisfactory.
[0054] In this way, according to this FM/TV receive section, although the voice of FM broadcasting and television broadcasting is receivable, the rise of cost can be suppressed that what is necessary is just to prepare VCO21 and its one resonance circuit (not shown).
[0055] And the variability region of the oscillation frequency f0 of VCO21 is . Low band of FM broadcasting and television broadcasting ... 152.3 MHz - 216.3MHz High band of television broadcasting ... It is 156.35 MHz - 197.25MHz. That is, the variability region of the frequency f0 needed when receiving the voice of the high band of television broadcasting is included in the variability region of the frequency f0 when receiving the voice of the low band of FM broadcasting and television broadcasting.
[0056] Therefore, VCO21 and its resonance circuit are easy to be old things, and since they do not have to consider as a special configuration, they can suppress the rise of cost also from this point. Therefore, 3 band receiver of AM/FM/TV is realizable at the almost same cost as 2 band receiver of FM/AM.
[0057] Furthermore, most circuits can be IC-ized, therefore IC for reception of the voice of FM broadcasting and television broadcasting can be offered with one chip.
[0058] In addition, in ****, the division ratio of frequency dividers 31 and 32 can also be made into other values. Moreover, it can also unite with the receiving circuit of AM broadcast.
[0059]
[Effect of the Invention] According to this invention, in a FM/TV receiver, the rise of cost can be suppressed that what is necessary is just to prepare one local oscillation circuit. And the variability region when receiving the voice of the low band of FM broadcasting and television broadcasting is sufficient as the variability region of the oscillation frequency of that local oscillation circuit, therefore since it does not have to consider a local oscillation circuit as a special configuration, it can suppress the rise of cost also from this point.
[0060] Furthermore, most circuits can be IC-ized and IC for reception of the voice of FM broadcasting and television broadcasting can be offered with one chip.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the schematic diagram showing one gestalt of this invention.
[Drawing 2] It is drawing of the numerical table for explaining this invention.
[Drawing 3] It is the schematic diagram showing an example of a FM/TV receiver.
[Description of Notations]
2 Branch Circuit
4 1st Mixer Circuit
8 Adder Circuit
11 Low Pass Filter
13 Demodulator Circuit
20 PLL
21 VCO
31 32 Frequency divider
61 62 Mixer circuit
71 72 Phase-shifting circuit

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CLAIMS

[Claim(s)]
[Claim 1] The 1st oscillator circuit which forms the 1st local oscillation signal, and the voice broadcast wave signal of television broadcasting with the local oscillation signal of the above 1st While the 1st mixer circuit which carries out frequency conversion to the 1st intermediate frequency signal, the 1st intermediate frequency signal of the above, and the broadcast wave signal of FM broadcasting are supplied alternatively This supplied signal with 2nd 1 to local oscillation signal with which a phase intersects perpendicularly mutually One pair of 2nd mixer circuits which carry out frequency conversion to one pair of intermediate frequency signals, and one pair of phase-shifting circuits which perform phase shift processing to the one above-mentioned pair of intermediate frequency signals outputted from this 2nd mixer circuit, The arithmetic circuit which outputs a signal including the intermediate frequency signal of the broadcast wave signal which calculates the output signal of one pair of these phase-shifting circuits, and is made into the purpose, The filter which takes out the intermediate frequency signal of the broadcast wave signal made into the above-mentioned purpose from the output signal of this arithmetic circuit, The radio set it was made to have the demodulator circuit which the output signal of this filter is supplied and restores to a sound signal, and the frequency divider which carries out dividing of the local oscillation signal of the above 1st, and forms the local oscillation signal of the above 2nd.
[Claim 2] It is the radio set with which the receiving band of the above-mentioned television broadcasting is made into the high band of the above-mentioned television broadcasting, and the receiving band of the above-mentioned FM broadcasting was made to be made into the low band of the above-mentioned FM broadcasting and the above-mentioned television broadcasting in the radio set according to claim 1.
[Claim 3] The radio set with which the division ratio of the above-mentioned frequency divider was changed so that it might set to a radio set according to claim 2 and the variability region of the oscillation frequency of the local oscillation signal of the above 2nd at the time of reception of the high band of the above-mentioned television broadcasting might become narrower than the variability region of the oscillation frequency of the local oscillation signal of the above 2nd at the time of reception of the low band of the above-mentioned FM broadcasting and the above-mentioned television broadcasting.

[Translation done.]